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DOI: https://doi.org/10.1159/000334396

Paper

Human Development 2011;54:349–367
DOI: 10.1159/000334396

Human Development

Normal Aging and Decision Making: The Role of Motivation

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Key Words
Decision making · Lifespan development · Motivational development · Normal aging · Personal goals

Abstract
The main argument of this review is that motivational development associated with normal aging affects decision making. With increasing age, the ratio of gains to losses becomes more and more unfavorable. Reflecting the increasing losses in resources, goal orientation changes from a predominant orientation towards gains in young adulthood to an increasingly stronger orientation towards the prevention of loss in older adulthood. As goals serve as reference points for the evaluation of decision outcomes, this change in goal orientation across adulthood might also affect decision making. The decision-making literature has recognized that choices are influenced by goal orientation. However, little research has been conducted on how goals influence the decision-making process in general and with regard to aging in particular. To date, findings on decision making and aging remain inconsistent and are in need of a developmental framework. With regard to applications, a better understanding of the aging decision maker can provide insight into how to improve communication efforts about issues like advance care planning, medical treatment, and housing options.

Older adults face important and complex decisions such as which health care provider to choose, which housing arrangements to make, or how to manage their financial resources. Understanding age-related changes in the decision process may help us to design decision contexts in a way that enables older adults to make optimal

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decisions. Only little is known, however, on the effect of normal aging on decision making [Mata, Josef, Samenez-Larkin, & Hertwig, 2011; Mather, 2006; Sanfey & Hastie, 2000].

One of the main propositions of lifespan psychology is that aging does not represent a uniform trajectory across different domains of functioning, but instead is multidirectional [Baltes, 1987]. In other words, normal aging comprises different developmental changes in different functional domains such as cognition, emotion, and motivation. For instance, whereas fluid intelligence declines across adulthood, crystallized intelligence is fairly stable well into old age [Li et al., 2004]. These age-related cognitive changes have been shown to influence decision making in older adults [e.g., Bruine de Bruin, Parker, & Fischhoff, 2010; Mata, 2007; Mata, Schooler, & Rieskamp, 2007; Peters & Bruine de Bruin, 2011]. Importantly, different kinds of decision-making tasks may draw more or less on fluid or crystallized aspects of cognitive functioning such as information processing speed or working memory capacity, on the one hand, or on experience in making choices and in dealing with gains and losses associated with their choices, on the other [Mata et al., 2011]. Thus, it is not surprising that there is empirical evidence supporting an age-related decrease as well as stability in decision-making competence [for reviews, see Bruine de Bruin et al., 2010; Yoon, Cole, & Lee, 2009].

Going beyond cognitive functioning, some authors have drawn attention to the importance of socioemotional changes [e.g., Mather, 2006; McCarrey, Henry, & Luszcz, 2010]. In particular, there seems to be an age-related increase in people's reliance on affective information, which may allow older adults to compensate for cognitive decline in some decisions [Finucane, 2008; Hanoch, Wood, & Rice, 2007; Peters & Bruine de Bruin, 2011]. A meta-analysis on predecisional information search suggested that the aging decision maker tends to consider fewer pieces of information when making decisions, but that this may lead to only minor losses in decision quality, reflecting an effective strategy [Mata & Nunes, 2010]. There is also an emerging literature on neuroeconomics and aging that covers neuropsychological changes in older adulthood and their impact on decision making [for reviews, see Brand & Markowitsch, 2010; Brown & Ridderinkhof 2009; Mohr, Li, & Heekeren, 2010]. In addition to age-related cognitive, neuropsychological, and socioemotional changes, we posit that *motivational* changes regarding people's orientation towards gains and losses also influence how they make decisions in different areas of their lives. It is interesting that age-related motivational changes in people's goal orientation towards gains or losses have largely been neglected in decision-making research. This is surprising as the motivational concept of goals plays a crucial role in the decision-making process, particularly in the evaluation of choice options. For instance, Yates and Patalano [1999] stressed that the special nature of decision making lies in the subjective value of what is perceived as a satisfying outcome. The construal of what constitutes a satisfying outcome most likely depends on what the decision maker wants to achieve or avoid, respectively.

As Hastie [2001, p. 656] put it: 'Good decisions are those that effectively choose means that are available in the given circumstances to achieve the decision maker's goals.' According to this definition of a 'good choice,' the decision maker's goals and the means at his or her disposal are essential in the decision-making process. Importantly, both goals and available means are subject to developmental change. Hence, we posit that age-related changes across adulthood in the predominant motivation

to achieve gains or avoid losses are related to age-related changes in decision making. Note that we do not advocate the notion of a general decline in decision-making 'performance', with older adults making worse decisions than younger adults. Instead, we argue that, although adults of all ages want to achieve gains and avoid losses when making decisions, younger adults might be more motivated than older adults to base their decisions on the motivation to achieve gains. In contrast, older adults might be more motivated than younger adults to avoid losses when making decisions.

Two of the most striking changes that occur in normal aging are an increase in losses in various life domains (e.g., fluid intelligence, physical performance, health) and a decrease in gains [Baltes & Smith, 2003], leading to an overall decline in the availability of resources [Baltes, 1997]. How does the experience of this change in gains and losses and the availability of resources across adulthood affect how we make decisions? We posit that motivational changes related to the changing ratio of gains to losses across adulthood profoundly affect the process of decision making. More specifically, we propose that age-related changes in goal orientation from a predominant gain orientation to an increasing importance of the prevention of losses across adulthood [Freund & Ebner, 2005] affect decision making in the following way: the goal of preventing losses might increase the salience of potential losses (relative to gains) when older adults make a decision. The corresponding 'vigilant' or conservative decision-making strategy aims at avoiding losses by reducing costly errors and helping to evade threat [e.g., Crowe & Higgins, 1997]. Hence, the aging decision maker may show a stronger sensitivity to losses and a weaker sensitivity to gains as compared to younger adults. Note that our perspective does not conflict with the idea that decision making in older adults might be affected by cognitive, neuropsychological, and socioemotional changes. Instead, we believe that motivational changes across adulthood and their potential impact on decision making have been largely overlooked in the literature. We posit that motivational changes in people's orientation towards gains and losses influence information processing and decision strategies. Complementing research on older decision makers' stronger reliance on affective information [Finucane, 2008], we hypothesize that the motivational orientation towards gains or losses may influence the *kind* of affective information (gain- vs. loss-related information) older adults rely on more.

In sum, this review elaborates on how motivational changes in goal orientation associated with normal aging may affect the decision-making process. This paper is divided into six sections: (a) the dynamics of gains and losses in normal aging, (b) goal orientation across adulthood, (c) motivational factors in decision making, (d) gains and losses in decision making and aging, (e) key issues for future research, and (f) applied consequences.

The Dynamics of Gains and Losses in Normal Aging

Developmental gains and losses are present throughout the entire life span and involve internal as well as external resources (e.g., sensorimotor, cognitive, physical, and social resources) [Baltes, 1987, 1997]. With increasing age, adults increasingly face losses in resources due to declining health and cognitive functioning, retirement, and the death of loved ones [e.g., Baltes & Smith, 2003]. There is high consensus among adults of all ages regarding the expectation of predominating gains in

younger adulthood and an increasing number of losses in middle and late adulthood [Heckhausen, Dixon, & Baltes, 1989; Heckhausen & Krueger, 1993; Mustafic & Freund, 2011].

According to Hobfoll's [1998] conservation of resources theory, when people are faced with the threat of resource losses, preventing loss becomes more important than acquiring new resources [see also Freund & Riediger, 2001]. Accordingly, as people age and thereby increasingly encounter losses, their goal orientation should shift from growth (gains) in young adulthood to maintenance and prevention of loss in older adulthood [e.g., Ebner, Freund, & Baltes, 2006; Freund, 2006; Freund & Ebner, 2005; Heckhausen, 1997; Staudinger, Marsiske, & Baltes, 1995]. Goal orientation is likely to influence decision making by influencing information processing as well as the evaluation of decision outcomes. Whereas younger adults may process decision-related information and evaluate decision outcomes primarily with respect to gain maximization, older adults may focus more on and favor information related to outcomes that ensure the avoidance of losses.

Goal Orientation across Adulthood

In the motivational literature, there is a fundamental distinction between approach and avoidance motivation [e.g., Emmons, 1996], which corresponds roughly to a distinction between goals that are oriented towards gains or growth and goals that are oriented towards the maintenance of functioning or the avoidance of loss [Freund & Ebner, 2005]. Similarly, the regulatory focus theory [Higgins, 1998] distinguishes between promotion and prevention focus where promotion focus describes the orientation towards approaching something desired and prevention focus the orientation towards avoiding something undesired. Regulatory focus is also reflected in strategies of goal pursuit as either eager (i.e., attempting not to leave out any possibility to promote gains) when adopting a promotion focus or as vigilant (i.e., attempting to avoid any risks and watching out for possible danger of losses) when adopting a prevention focus.

Across adulthood, motivation shifts from a primary growth orientation (i.e., achieving gains) to an increasing importance of maintaining resources and preventing losses [Freund & Ebner, 2005]. Ebner et al. [2006] found that younger adults described their personal goals as primarily oriented towards growth, whereas middle-aged and older adults increasingly described their personal goals as being directed at maintenance and prevention of loss. Converging evidence is provided by self-report studies of personal goals by Heckhausen [1997] and Ogilivie, Rose, and Heppen [2001]. Experimental studies suggest that this shift is due to the availability of resources. Younger adults shifted from a gain to a loss orientation when their resources were perceived as restricted [Ebner et al., 2006].

Is this shift in goal orientation adaptive? In the study by Ebner et al. [2006], loss orientation was negatively related to subjective well-being in young but not older adults, and maintenance orientation was even positively associated with subjective well-being in older adults. In younger adults, goal orientation towards the avoidance of losses was correlated negatively with subjective well-being. This speaks for an age-differential adaptiveness of goal orientation across adulthood. Further attesting to this pattern, Freund [2006] found in a set of experiments that older adults were more

persistent in pursuing a task geared towards counteracting losses, whereas younger adults were more persistent when they pursued the same task geared towards achieving gains. We find it interesting that this age-related difference in persistence was unrelated to task performance. In other words, the driving force for persisting in goal pursuit was not how well younger or older adults performed on it but, instead, the framing of the task as gain or loss related. Taken together, these studies provide empirical evidence supporting the notion of a shift in goal orientation from gains to losses across adulthood that is adaptive regarding behavioral indicators of motivation as well as subjective well-being. The consequences of this shift in goal orientation on decision making in normal aging will be discussed in greater detail after a review of studies on the impact of motivation on decision making.

Motivational Factors in Decision Making

Economists usually view behavior as an attempt to maximize gains and minimize losses or as the quest for pleasure and the escape from pain [e.g., Camerer, Loewenstein, & Prelec, 2005]. Although it has long been recognized that choices are influenced by goals [e.g., Heath, Larrick, & Wu, 1999; Higgins, 1998; Kahneman & Tversky, 1979; Rangel, Camerer, & Montague, 2008; Tversky & Kahneman, 1981; Yoon et al., 2009], the way in which goals influence choice has largely been neglected. For instance, the prospect theory proposes that the value (utility) of an outcome is the result of how far it deviates positively or negatively from a reference point [Kahneman & Tversky, 1979]. Although it has been acknowledged that goals may serve as reference points in the evaluation of outcomes [Heath et al., 1999; Kahneman & Tversky, 1979; Locke & Latham, 1990; Mento, Locke, & Klein, 1992; Tversky & Kahneman, 1981], most applications of the prospect theory have not taken individual goals into account. Instead, the status quo is assumed to serve as a reference point. Taking the notion of personal goals as setting comparison standards seriously, one might assume that goal orientation has an important impact on the evaluation of an outcome, independent of the status quo. For instance, if the goal is to prevent a serious loss, a less severe loss might be experienced as a gain. Conversely, if the goal is to achieve a very high gain, a lower gain might be experienced as a loss. Similarly, Idson, Liberman, and Higgins [1999] argued that the difference in hedonic experience of gains and losses (i.e., as how rewarding or punishing an outcome is experienced) depends on the person's motivation to either promote gains or prevent losses. More specifically, they argued that the presence or absence of a gain (gain vs. non-gain) or a loss (loss vs. non-loss) is experienced differently depending on whether a promotion or prevention focus was adopted. When trying to prevent a loss, not losing can feel like winning. A gain will usually be experienced as pleasurable, but may be experienced as even more pleasurable if it was not expected [e.g., Mellers, 2000]. In sum, the value of an outcome is subjective and depends not only on the status quo, but also on the decision maker's goals and expectations. This, in turn, might influence the decision-making process. As argued by Mellers [2000] in her subjective expected pleasure theory, decision makers anticipate the pleasure and pain of outcomes and select choices with greater average pleasure.

To date, most studies directly investigating the impact of goals on decision making have only used samples of young adults. Some have argued that existing research

on how goals influence decisions under uncertainty[1] in young adults suggests that pursuing a goal increases risk taking. For instance, in one experiment participants cheated more when they wanted to reach a certain goal [Schweitzer, Ordóñez, & Douma, 2004]. In another study, participants accepted more risks to reach an actual monetary goal [Larrick, Heath, & Wu, 2009]. Note, that these studies investigated decision making in the context of gain-oriented goals.

Very few studies have investigated the differential effects of goals directed at growth or at the prevention of loss on decision-making strategies. In one of the few exceptions, Crowe and Higgins [1997] looked at the effect of an experimentally induced prevention or promotion focus in young adults on the performance in a signal detection paradigm. In this task, participants had to press 'yes' or 'no' depending on whether a signal was presented or not. The authors found that young participants with an experimentally induced prevention focus had a bias towards pressing 'no' (i.e., adopting a vigilant strategy). Conversely, persons with an experimentally induced promotion focus had a bias to press 'yes' (i.e., adopting an eager strategy). The authors argue that these biases reflect differences in the general decision strategies used when people hold a prevention or a promotion focus: according to Crowe and Higgins, prevention focus is associated with the tendency to be cautious in order to avoid mismatches to desired end states (vigilant strategy), whereas a promotion focus is related to jumping at opportunities that might help one to achieve desired end states (eager strategy). Further supporting the notion that a conservative or vigilant decision strategy is used when a prevention focus is adopted, Chernev [2004] found in a study on consumer preferences that young adults more strongly preferred the status quo over changing their selection of an object (here: a digital camera) when they had been primed to be prevention- as compared to promotion-focused.

Importantly in the current context, these studies demonstrate that people's decision strategies are related to their motivation to promote growth or prevent losses. Note that these studies were based on college-aged samples and, therefore, cannot address possible age-related effects. They can be used, albeit with caution, as a basis for speculating about decision-making differences between gain-oriented (promotion-focused) younger adults and loss-prevention-oriented older adults. Motivational changes in goal orientation might lead older adults to become more vigilant and conservative decision makers in order to avoid further losses and secure the maintenance of resources. This might lead to an increasing asymmetry in the importance older adults place on losses compared to gains when making decisions, such that they become more sensitive to and react more strongly to losses than younger adults do. Consequently, older adults might attend more to information related to potential losses when making a decision, and to weigh such information more heavily than gain-related information. Increased motivation to avoid losses in older adults might also be associated with a preference for familiar options in order to minimize the chances of unpredictable losses. In repeated or rule-based decisions, an increase in loss orientation in older adults may result in a response bias to avoid costly errors rather than maximize possible gains (similar to those shown by Crowe and Higgins [1997] in younger, prevention-focused adults).

[1] In the decision-making literature, 'uncertainty' typically refers to situations in which outcomes are unknown and uncertain, whereas in risky situations uncertainty can be predicted by defined probabilities [e.g., Bechara, 2004].

Note that there may be fundamental differences between older adults' general goal orientation towards the prevention of losses and younger adults' adoption of a prevention focus. For younger adults, having to prevent losses might constitute the exception to the rule of maximizing gains. As a consequence, they might react even more strongly to losses than older adults for whom losses are expected and more common. Moreover, for older adults, the prevention of a loss might actually be motivating and considered positive [Ebner et al., 2006; Freund, 2006]. In contrast, for younger adults having to prevent losses might be a stronger signal of something going wrong because losses are rather unexpected during this phase of the life span [Freund & Riediger, 2001].

Gains and Losses in Decision Making and Aging

In the classic decision-making literature, gains and losses mostly refer to monetary gains and losses in experimental decision-making tasks. Asymmetries in gain-loss processing in decision making are well accepted: loss aversion, for example, has been called 'the most successful and widely used explanatory construct in behavioral decision research' [Brenner, Rottenstreich, Sood, & Bilgin, 2007, p. 369; for critical perspectives on when loss aversion occurs, see Hertwig, Barron, Weber, & Erev, 2004; Yechiam & Ert, 2011]. Loss aversion denotes a higher impact of losses on a choice than do equivalent gains. The construct was initially formalized as a component of the prospect theory, an analysis of risky choices to explain risk aversion in monetary decisions [Kahneman & Tversky, 1979; Tversky & Kahneman, 1992].[2] Loss aversion was also used in the domain of riskless choice to explain effects such as the endowment effect [Kahneman, Knetsch, & Thaler, 1990] and other phenomena [see Novemsky & Kahneman, 2005]. According to the prospect theory, changes for the worse (losses) loom larger than equivalent changes for the better (gains) [Kahneman & Tversky, 1984; Tversky & Kahneman, 1991]. For example, when asked to accept or reject a 50:50 bet to either win or lose a certain amount of money, participants usually accept when the potential gain is at least twice as high as the potential loss. This reflects a strong asymmetry of gains and losses in decision making. Despite the seeming ubiquity of loss aversion, the literature suggests that decisions from experience differ strongly from decisions from description [Hertwig et al., 2004]. Moreover, Yechiam and Ert [2011] found only moderate consistency within subjects across different tasks and between description-based problems presented in different domains. We propose that loss aversion might also depend on the decision maker's goal orientation. In the following, findings about *age-related changes* in the asymmetry of gains and losses in decision making will be reviewed.

On the basis of the motivation literature, we argued above that older adults might be more sensitive to and place greater importance on losses than younger adults during the decision-making process. Findings from the reinforcement learning literature are in line with this reasoning. Frank and Kong [2008] showed that age

[2] Note that, within the framework of the prospect theory, risk does not denote uncertainty, but the precise probabilities of several specific alternatives such as the 10% probability of dying of unwanted side effects after receiving a vaccine that, on average, increases the probability of surviving a corresponding infection to 80%.

had a significant effect on the bias to avoid negative outcomes. Older seniors (mean age = 77 years), but not younger seniors (mean age = 67 years), showed an increased tendency to learn from the negative as compared to positive consequences of their decisions in a probabilistic selection task. This finding supports the idea that older adults grow increasingly vigilant towards losses. Moreover, the difference between younger and older seniors shows that the tendency to learn from losses becomes increasingly pronounced in old age. Note, however, that a recent meta-analysis by Mata et al. [2011] showed that, in general, older adults seem to profit less from feedback in repeated decisions. The authors interpret this finding as reflecting age-related cognitive changes that make learning more difficult for older compared to younger adults.

A number of studies that investigated asymmetries in the processing of gains and losses in decision making employed the Iowa Gambling Task (IGT) [Baena, Allen, Kaut, & Hall, 2010; Bechara, Damasio, Damasio, & Anderson, 1994; Denburg, Bechara, Tranel, Hindes, & Damasio, 1999; Denburg et al., 2007; Denburg, Recknor, Bechara, & Tranel, 2006; Denburg, Tranel, & Bechara, 2005; Kovalchik, Camerer, Grether, Plott, & Allman, 2005; MacPherson, Phillips, & Della Sala, 2002; Wood, Busemeyer, Koling, Cox, & Davis, 2005]. The results of this line of studies present a mixed picture. The IGT requires participants to draw cards consecutively from different decks that correspond to different monetary losses and gains. The correspondence of decks to gains and losses is unknown to the participants. There are 4 decks, 2 of the decks with high payouts but even higher losses, and 2 decks with low payouts but also lower losses. The aim of the task is to win as much money as possible by making advantageous card selections. Selections from the low-gain/low-loss decks produce a net gain across trials, whereas selections from the high-gain/high-loss decks produce a net loss across trials. Participants ideally develop a bias towards the advantageous decks resulting in a net gain across trials. Less advantageous decisions in the task favor larger versus smaller rewards, despite the large losses associated with the same deck and thus long-term negative consequences. The trials are divided into blocks, which allows comparing the proportion of advantageous selections across blocks as an indicator of learning. Denburg et al. [1999] tested a population of healthy older adults with the IGT and found that older adults did not demonstrate a shift over time from the decks that produce a net loss to the decks that produce a net gain. Fein, McGillivray and Finn [2007] replicated the finding that older adults choose less advantageously compared to young adults and showed a positive association of older adults' performance with immediate memory. As pointed out by Mata et al. [2011], this might be due to decreased learning from feedback in older adulthood. In other studies, Denburg et al. [2005, 2006, 2007, 2009] found that performance on the IGT might be impaired in a subset of older adults. Furthermore, Denburg et al. [2006] administered the IGT and measured psychophysiological correlates of decision making (anticipatory skin conductance responses that participants produced immediately prior to the response) in a sample of elderly participants. Older adults with nonimpaired decision making on the IGT showed a stronger physiological response to anticipated gains than to anticipated losses. In contrast, younger adults responded more strongly to anticipated losses than gains. Older adults with impaired decision making on the IGT did not demonstrate discriminatory anticipatory skin conductance responses for advantageous versus disadvantageous choices. Thus, learning from feedback in repeated decision-making tasks seems to be associated with (and may even depend on) an intact discriminatory response to gains and losses. Where-

as these findings seem to suggest that younger adults learn more from loss-related feedback over time than older adults, other studies could not replicate these findings. For instance, several studies found no significant age-related differences in IGT performance [Baena et al., 2010; Lamar & Resnick, 2004; MacPherson et al., 2002]. Similarly, Kovalchik et al. [2005] showed that older adults shifted to the gain payoff decks just like younger adults did. The analyses of the IGT by Wood et al. [2005] showed that older adults' strategies differed in several ways: older adults exhibited larger recency effects and faster forgetting of previous outcomes. Furthermore, older adults placed equal emphasis on gains and losses whereas younger adults placed greater weight on losses. Importantly, older adults showed symmetrical weighting of gains and losses that contrasted to the 'negativity effect' reflected in the responses of young adults, who were greatly influenced by losses. This symmetrical weighting of gains and losses has been interpreted as an accurate representation of gains and losses [Peters & Bruine de Bruin, 2011].

The majority of these findings suggest unimpaired performance on the IGT in older adults in that they shift to advantageous decks across trials. However, as the analyses by Wood et al. [2005] suggest, unimpaired performance on the IGT can be a result of different strategies. The task was originally developed to capture the integration of emotion and cognition in decision making [Bechara et al., 1994]. The task comprises a variety of features such as weighing risks and benefits, making decisions under uncertainty and dealing with unknown outcomes [Denburg et al., 2009]. Although the task requires dealing with gains and losses, unfortunately, it does not assess the sensitivity to gains and losses. In fact, there has been some criticism in the literature that it is unclear what the IGT actually measures. For instance, Frank and Kong [2008] suggest that the IGT might be sensitive to age-related decline in working memory. More precisely, trial-to-trial behavior on the IGT might reflect sensitivity to the recency of positive and negative outcomes, which may depend more on working memory than on learning. Another problem with interpreting decision behavior on the IGT as reflecting sensitivity towards gains and losses is that it might tap more into risk attitudes (risk aversion and risk seeking), as the probabilities of gains and losses vary in the task. In a meta-analysis on risk preferences, Mata et al. [2011] showed that in decisions from experience (as, for instance, required by the IGT) age-related differences in risk-taking were driven by decreased learning in older adults. Older adults act more risk averse compared to young adults, when learning led to risk-seeking behavior. In contrast, older adults were more risk seeking compared to younger adults when learning resulted in risk avoidance [Mata et al., 2011]. Age-related difference in the performance on the IGT (and potentially also on other experience-based decision tasks) might partly depend on an age-related decrease in learning. If learning is a necessary process for performance on the IGT, it is unlikely that motivational effects modulate age-related differences. Put differently, age-related difference in motivation might not have a chance to influence performance on the IGT if older adults have more problems learning the risk contingencies. Therefore, in tasks such as the IGT or other decision tasks involving learning, we do not expect age-related differences in motivation to play an important role for risk aversiveness. More generally, the monetary incentives could lead to systematic differences between age groups. This might be the case because monthly income as well as the general importance of money may differ (as will be discussed below in more detail). In addition, people do not appear to exhibit loss aversion for small amounts of mon-

ey. On the contrary, people expect small gains to be more pleasant than they expect small losses to be unpleasant [Harinck, Van Dijk, Van Beest, & Mersmann, 2007]. Hence, the reward structure in the IGT may not be suitable to measure loss aversion or single out the impact gains and losses have on task performance.

Another set of studies that investigated the asymmetries of gains and losses in old age employed the monetary incentive delay task (MID task) [Knutson, Adams, Fong, & Hommer, 2001]. In each MID task trial, participants view 1 of 6 different cues displaying the amount of money that can be gained or lost on that trial (anticipation phase). If the participant responds quickly enough to a subsequent target, he or she either gains money or avoids losing money (outcome phase). Importantly, this task does not require a decision. However, the task allows distinguishing between the anticipation of gains versus losses. Using the MID task, Nielsen, Knutson and Carstensen [2008] found that older adults showed less increase in arousal when anticipating a loss compared to a gain, whereas younger adults showed increased negative arousal during loss anticipation and positive arousal during gain anticipation. Moreover, older adults showed less relief compared to young adults when a loss did not occur even if it was expected. The authors concluded that these findings support the hypothesis that older adults experience less negative emotions than young adults and that they may better predict dynamic changes in affect. Yet, as mentioned above, in the case of small monetary gains and losses, loss aversion reverses such that people expect small monetary gains to be more pleasant than they expect small losses to be unpleasant [Harinck et al., 2007]. Given this finding, the results presented for older adults are not surprising with respect to the size of the monetary gains and losses employed in the study. The highest gain or loss was USD 5, which can be considered small in terms of Harinck's findings [Nielsen et al., 2008]. The finding that older adults reported increased positive arousal on trials involving gain anticipation but no increase in negative arousal on trials involving loss anticipation might be due to the small magnitude of expected losses. In contrast, younger adults show increased negative arousal during loss anticipation and increased positive arousal during gain anticipation. In this case, the authors acknowledge that older adults seem better in affective forecasting. Note also that this study used monetary incentives, which might be stronger for younger as compared to older adults [Freund & Blanchard-Fields, 2011]. Thus, in our view, the results of the study by Nielsen et al. [2008] do not allow us to conclude that older adults show a general tendency to experience less negative affect when anticipating loss. In fact, it seems more deserving of an explanation why younger adults *failed* to discount the small losses. One potential explanation could be that accumulated experience with losses has taught older adults to anticipate that small losses will not be very painful, thereby reducing an affective forecasting error.[3]

In another study, the MID task was used in event-related functional magnetic resonance imaging [Samanez-Larkin et al., 2007]. Results suggest similar patterns of

[3] Loss aversion has been argued to be an affective forecasting error in that people overestimate the hedonic impact of losses because they underestimate their tendency to rationalize losses and overestimate their tendency to dwell on losses [Kermer, Driver-Linn, Wilson, & Gilbert, 2006]. This argument is based on findings from a gambling task. It may be that the smaller forecasting error ('forecasting expertise') older adults showed in the study by Nielsen et al. [2008] for small monetary gains expands to other kinds of gains as losses (larger gains and losses, nonmonetary gains and losses).

neural activation in young and older adults during anticipation of gains (increased ventral striatal activation in both groups) but not of losses (increased insular and medial caudate activation in younger, but not in older participants). Importantly, the observed differences between younger and older adults pertained to the *anticipation* of losses. There were no differences in response to the negative outcomes themselves. Samanez-Larkin et al. [2007] concluded that these findings present an asymmetry in the processing of gains and losses in older compared to young adults. They argue that this difference is important in decision making. However, the MID task does not comprise decisions. Therefore, only conclusions can be drawn about how age groups process and anticipate certain outcomes. Seen in this light, the findings of these two MID studies support the notion that older adults expect to experience losses, whereas younger adults expect to experience gains [Heckhausen et al., 1989]. Currently, we can only speculate about how anticipated outcomes and the subjective anticipated pleasure or pain affects actual decision making. In the MID task, participants control the outcomes by reacting as fast as possible. As reaction times decrease with age, older adults might have experienced less control over the outcomes in the presented studies. As a consequence, older adults might expect losses in loss trials and no win in gain trials. This, in turn, might result in differences between older and young adults in subjectively experienced pleasure, as the standards of comparison are different for older and young adults (see above) [Mellers, 2000]. This might be particularly important when people have to make a decision. In fact, it would be very interesting to employ MID task that requires a decision when investigating adult age differences in gain and loss sensitivity for the decision-making process.

In a study on risky decision making employing the cups task [Levin & Hart, 2003], Weller, Levin and Denburg [2010] showed that age-related differences in risky decision making occurred depending on whether the expected outcome constituted a gain or a loss. In the cups task, there are distinct trials in which the participants can either achieve small monetary gains or avoid small monetary losses. Unlike the IGT, the cups task does not involve mixed outcomes of gains and losses. Results show that younger and older adults' willingness to take a risk did not differ in the loss trials. Yet, older adults were less willing to take a risk in the gain trials [Weller et al., 2010]. Older adults, then, may be less willing to accept a potential loss (not winning) when they can prevent it. When facing a loss, however, and taking a risk becomes the only means to avoid the loss, younger and older adults do not differ in their performance on the task.

In another study on risky decision making, Mikels and Reed [2009] developed a new monetary incentive task in which young and older adults chose between sure options and risky gambles. The authors showed that positively framed options appear to have an equal impact on older and younger individuals but that negatively framed options lead to a greater willingness to take a risk in older adults [Mikels & Reed, 2009]. This result contrasts the findings of Weller et al. [2010] leading to a mixed picture regarding risky decision making in old age. Again, one could argue that, although the decisions are personal and nonhypothetical, monetary incentives might not be equally important to both age groups. Additionally, the gambles entail different probabilities for both gains and losses within one option, which might make the task difficult to understand for participants [for a discussion of the difficulties in understanding probabilities, see Gigerenzer, 1997; Cosmides & Tooby, 1996].

In conclusion, findings on age-related differences in the asymmetry of the impact of gains and losses on decision making are inconsistent [see also Mata et al., 2011]. Frequently, symmetries in the processing of gains and losses in older adults are contrasted to an emphasis on losses in younger adults and interpreted as a positivity bias in older adulthood. Clearly, more research is needed to understand the potentially changing relative impact of gains and losses on decision making across adulthood. The methodological shortcomings in the studies reviewed above need to be addressed in future studies before a conclusion can be drawn. More specifically, the tasks used in these studies should require decisions, monetary incentives should be large enough to detect the 'losses loom larger' effect, and performance on the task should not be bound to reaction times, which are well known to decrease in older adulthood [e.g., Li et al., 2004]. As we will point out in the following section, it might be useful to employ nonmonetary incentives when studying aging and decision making. Finally, if the decision makers' goals influence decision making as situational factors, these may result in a variation of the sensitivity to losses across different decision domains.

Key Issues for Future Research

To date, the empirical basis is insufficient to allow well-grounded conclusions about the way motivational development in aging influences decision making. However, the implications of motivational changes may be relevant to understanding the aging decision maker and may also help to explain current inconsistencies in research on decision making and aging. Understanding the aging decision maker can provide insight into how to improve communication efforts about issues such as advance care planning, medical treatment, or housing options.

In addition to the methodological suggestions above, several issues need to be addressed in future research: the kinds of incentives employed in experimental studies on decision making (monetary vs. nonmonetary incentives), the comparison of decision making in different life domains, and the dynamics across different phases in decision making.

Monetary and Nonmonetary Incentives

Most of the studies reported above investigated decision making in tasks with monetary gains and losses. However, money might not be equally important to young and older adults [Mata et al., 2011]. In fact, a study by Freund and Blanchard-Fields [2011] suggests that there might be age-related change in the incentive value of money. When facing a trade-off between the maximization of one's personal monetary outcome and the protection of the environment, older adults were more environmentally minded at the cost of actual monetary payment, whereas the opposite pattern was true for younger adults. Moreover, older adults were more willing to donate money they had earned for participation in an experiment to a good cause instead of keeping it for themselves. Obviously, an important advantage of monetary incentives is that gains and losses can be easily experimentally manipulated and balanced in magnitude of absolute value. In contrast, it is very difficult to

balance the magnitudes of gains and losses in nonmonetary incentives. However, when investigating the relative impact of gains and losses, it is crucial to establish an equivalence of the intensity of gains and losses in order to rule out an intensity effect [Peeters & Czapinski, 1990]. When comparing age groups, balancing the intensities of stimuli becomes even more complex. Findings by Keil and Freund [2009] show that high emotional arousal was experienced as negative by older adults, regardless of whether the stimulus was positive or negative. In contrast, younger adults showed a clear pattern of rating more arousing positive stimuli more positively. If arousal becomes aversive in older adults, they might weigh certain outcomes differently than younger adults do regardless of the valence of the outcome. Thus, potential age differences in stimulus evaluation need to be taken into account. Stimulus materials should ideally be rated on both valence and arousal dimensions.

Domain-Related Differences

In evaluating options, decision makers may place different emphasis on either gains or losses depending on the domain (e.g., what the decision is about), such as finance, health or social relationships. Developmental expectations regarding gains and losses in different domains may underlie such domain-related differences [Mustafic & Freund, 2011]. Thus, the sensitivity to and weighing of gains and losses does not represent a domain-general trait but rather the interaction between the situation (e.g., availability of resources) and the decision maker (e.g., gain or loss orientation) [Figner & Weber, 2011; Yechiam & Ert, 2011]. Accordingly, the investigation of different decision domains that systematically vary along dimensions, such as the availability of resources, seems particularly interesting for further understanding under what conditions people are more likely to show loss aversion. Moreover, from a developmental perspective, some life domains grow increasingly important across adulthood while other domains may lose their importance. For example, social relationships become increasingly important in old age [Lang & Carstensen, 1994]. Moreover, research in the context of socioemotional selectivity theory has shown that the quality and satisfaction with social relations do not decline across adulthood but might even show gains [Carstensen, Isaacowitz, & Charles, 1999]. This might also be reflected in older adults' goal orientation, which might vary by life domain. Regarding social relations, younger and older adults might not differ regarding the importance they place on growth, maintenance, and the prevention of loss [Carstensen et al., 1999]. This might also affect the impact of gains and losses for decision making.

In contrast, physical functioning and health are subject to age-related decline [Baltes & Smith, 2003], which is also reflected in people's developmental expectations [Mustafic & Freund, 2011]. In these life domains, older adults might be particularly sensitive to losses and might show stronger loss aversion than younger adults. Improvement in communicating information about important health-related decisions may foster successful advance care planning for potential future health issues such as dementia. Hence, understanding how older adults perceive and process information in different domains may help to accomplish this. In sum, future studies should compare the sensitivity to losses in domains in which normative de-

velopmental losses are expected (such as declining health and cognitive functioning) and in domains that are not subject to developmental losses (such as social relationships).

Dynamics across the Decision-Making Process

As indicated above, age-related shifts in goal orientation may vary across life domains. Thus, older adults may flexibly shift between different decision-making strategies in different domains and contexts, such as description-based or experience-based decision tasks. In addition, decision makers may flexibly shift between different information-processing strategies and evaluations of the situation in different phases of the decision-making process. This may resolve some apparent contradictions in findings on older adults' processing of gains and losses in decision making. For example, an emphasis on losses when trying to prevent a loss seems most adaptive in the predecisional phases. This could change for postdecisional settings when the decision maker has no further control over the outcome. In this phase, focusing on negative or loss-related information has adaptive value only for future decisions, but can no longer affect the past. In repeated decision situations, then, learning from bad choices is possible. This reasoning is in line with the finding that older adults learn more from negative information in a reward-learning setting in which choices are repeated [Frank & Kong, 2008], but demonstrate a postdecisional positivity bias when this is not the case [Kim, Healey, Goldstein, Hasher, & Wiprzycka, 2008; Mather & Johnson, 2000]. As elaborated in the context of the IGT, when learning is involved in repeated decisions, older adults might profit less from feedback regarding past choices. In experience-based repeated decisions, the decision maker has to learn the value of options from experience when deciding between risky options. Given the age-related decrease in learning, age-related differences might reflect primarily decreased learning abilities rather than motivational changes [Mata et al., 2011]. Future studies are needed to dissociate age-related differences in motivation and learning differences in description-based repeated choices.

In conclusion, older adults may not only flexibly adjust their strategies across but also within situations, depending on perceived control and adaptive value of asymmetric evaluations of gains and losses. In our view, this area of research might be particularly fruitful for understanding aging and decision making. In order to address these ideas, future research needs to rely on such methods as process tracing (e.g., using a 'mouse lab' procedure) that allow to investigate information seeking behavior in different phases of the decision-making process and accompanying emotional responses (e.g., through the measurement of skin conductance responses) [Schulte-Mecklenbeck, Kühberger, & Ranyard, 2011]. A process-tracing approach can also help to clarify which underlying processes may be influenced by loss prevention. Based on the motivational literature and the impact of goals on information processing, we assume that attention and memory are particularly likely to be affected by goal orientation towards gains or losses [e.g., Van Lange, Kruglanski, & Higgins, 2011]. One important question in this regard concerns the process of information integration: how do younger and older adults integrate different aspects of information into a representation of the decision options? Do younger adults overrepresent gain-related information whereas older adults overrepresent loss-related

information? This question could be empirically addressed using think-aloud procedures during the decision-making process. Another approach to dissociate different processes in the decision-making process and their integration is offered by the elaboration of computational models. To our knowledge, there do not exist any models addressing the interplay of motivation and cognition in explaining age-related differences in the decision-making process.

Applied Consequences

Older adults frequently need to make informed choices about important issues such as health care, medical treatment, insurance, financial plans, advance care planning, and housing. However, informed decision making is a double-edged sword. On the one hand, it allows people to be autonomous and to make their own decisions regarding these important issues according to their own preferences. In favor of informed choice, some researchers argue that older adults can make advantageous decisions when complete information is available to them [Zamarian, Sinz, Bonatto, Gamboz, & Delazer, 2008]. On the other hand, this autonomy may also place a burden on decision makers as they are confronted with a vast amount of information and complex choice settings. As shown by Schwartz [2004], there might be something akin to a 'tyranny of choice,' in that having more options available leads to dissatisfaction with one's choice. Moreover, even if all information about all options is available, people are typically unable to process all of the information, which makes making optimal decisions on the basis of this information impossible [Simon, 1982]. This might be particularly true in old age when cognitive resources are even more limited than at younger ages [Mata, 2007; Mata et al., 2007]. Here, motivational factors might be particularly important for the selection of information. Thus, understanding the motivational factors influencing decision making in older adults can help to improve communication about options in areas such as advance care planning, medical treatment, and housing options. More specifically, an increasing motivation to prevent losses may lead to changes in decision-making strategies, information search, and processing. Hence, communication about choice alternatives should be adjusted accordingly in order to enhance the effectiveness of communication. Consequently, the information presented could be reduced by making information that is particularly important to the decision maker's goals salient, for example, information that is diagnostic for counteracting losses and the maintenance of a current state. The potential to counteract losses or maintain some level of functioning should be emphasized more strongly if the prevention of loss is a central goal for the decision maker. Hence, alternatives should be evaluated and communicated with respect to their potential to counteract losses. Furthermore, pointing out potential gains and benefits of options may be inefficient and suited more for communicating with younger adults. Additionally, understanding how older adults review and process information may lead to implications about how older adults should be instructed to approach choice situations. For instance, Löckenhoff and Carstensen [2007] showed that older adults reviewed more positive information on health care plans when asked to focus on their emotions and less positive information when instructed to focus on specific facts and details. Thus, instructing older adults to focus on facts may eliminate differences between older and younger adults.

Conclusion

In this article, we have argued that motivational shifts in goal orientation towards gains and losses might be important for understanding older adults' decision making. We propose that decision making might change across adulthood towards more vigilant and conservative decision-making strategies aimed at preventing losses. As of yet, the vast literature on loss aversion in decision making has not yet included a lifespan perspective. Findings available to date present a mixed picture of results. We posit that losses loom even larger in older adulthood, a time at which the motivation to prevent losses increases. Older adults might be more sensitive to potential losses than younger adults. This might have important applied implications for the presentation of information in complex decision contexts for older adults such as health care or financial planning.

Acknowledgements

The writing of this paper was supported by a dissertation fellowship granted by the Jacobs Foundation to Miriam K. Depping. The authors would like to thank Rich Gonzalez, Lael Schooler, and Hauke Heekeren as well as the Life-Management Group for helpful discussions of the ideas presented in this article. We are grateful to Tamara Herz for carefully editing the manuscript. Miriam K. Depping is a fellow of the International Max Planck Research School on the Life Course (LIFE).

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